

## REMARKS

### Introduction

The application enclosed herewith is a continuation-in-part of US Application Serial Number 09/744,205 filed 18 January 2001.

A first Office Action on the above application issued 28 February 2003 in which all claims, comprising claims 1-18 were rejected under 35 USC 103(a) as being unpatentable over Kaufman (US 4862032) or Yoshikawa (4703222) or Alexander (4845364) in view of GB 2295268.

A response to the first Office Action was filed on 28 May 2003 in which a series of amendments were filed, including amendments to the independent claims 1 and 14, and new claims 19 to 22, including a new independent claim 19.

A further, Final, Office Action issued on 20 June 2003 rejecting all independent claims as being unpatentable over Kaufman in view of Yoshikawa.

In the present application, the claim set has been substantially revised. However many of the independent claims contain only minor modifications over the claims of the parent application as originally filed. Therefore, Applicant has provided herewith a copy of the independent claims indicating the closest correlating claim of the parent application, and the changes to that claim of the parent application.

Applicant has also provided comments arguing the patentability of the present claim set in light of the rejections made in both of the Office Actions that issued on the parent application. Application respectfully requests favourable consideration of the remarks made below during examination of the present application.

### Claim rejections 35 U.S.C. §103(a)

In items 1 and 2 of the First Official Action on US Application Serial No. 09/744205, the Examiner rejected claims 1-18 under 35 U.S.C. §103(a) as being unpatentable over Kaufman (US4862032), or Yoshikawa (4703222) or Alexander (4845364) in view of GB 2295268. Of these claims, claims 1 and 14 were the independent claims.

A new claim 19 was added in response to the first Office Action. Claim 19 was rejected in the second Office Action as being unpatentable over Kaufman in view of Yoshikawa.

Claims 1, 20 and 25 of the present claim set correspond with claims 1, 14 and 19 respectively of the parent application.

Claim 1 defines, *inter alia* “means for concentrating said electron flow to create a region within said ionisation region where the electron flux is a maximum ... wherein said gas supply terminates in at least one aperture disposed in proximity to said region of maximum electron flux”.

Claim 20 defines, *inter alia* “said anode has at least one surface exposed to said ionisation region, at least a portion of said at least one exposed surface being of an electrically conductive non-oxidising material”.

Kaufman teaches an annular anode 24 having a central aperture. Kaufman further teaches (column 9 line 61 to column 10 line 5, Figure 3) providing gas to the ionisation region through a distributor 42 and then through the central aperture of the anode 24 as well as downstream of the anode through gaps between the rings 38, 40 and the wall 34. That is, gas is distributed “*uniformly in a transverse direction within the ion source*” (claims 1 and 4).

At a distance from the anode 24 of Kaufman, electrons will tend toward the longitudinal axis. However, closer to the lower aperture of anode the electric field will disperse from the longitudinal axis toward the anode walls. The dispersing electric field will cause the electrons to disperse from the axis toward the anode walls. The magnetic field, being longitudinal may cause the electrons, now moving with a radial component, to bend in a circumferential direction due to well known  $E \times B$  forces. However, these forces will not tend to concentrate the electron flow. That is, Kaufman does not teach “means for concentrating said electron flow to create a region within said ionization region where the electron flux is a maximum “ as required by present claim 1. More specifically, Kaufman does not teach providing a concentration of the electron flow in proximity to where the gas is introduced, namely, the lower aperture of the anode and the upper circumference of the anode.

Kaufman teaches an ion source operating on the principle of dispersing the gas throughout the ionization region, and dispersing the electrons through the dispersed gas in order to produce the ion current. By contrast, the present invention as claimed in claim 1, requires a concentration of the electrons, and to introduce the gas in proximity to the electron concentration. Applicant respectfully submits that the claim language of claim 1 defines a patentable distinction over Kaufman.

Kaufman does not disclose an ion source as claimed in present claim 20 (previously claim 14 in the parent application as originally filed) because Kaufman is silent as to an ion source having an anode, the exterior surface of which is comprised of an electrically conducting, non-oxidising material. This point was conceded by the Examiner in the second official action issued on the parent application.

With respect, Applicant submits that the invention as defined by claim 25 (previously claim 19 in the parent application as amended) is not taught or suggested by Kaufman. Claim 25 defines that the *“gas supply path comprises a gas line terminating in an electrically conductive outlet member disposed within said ionization region, said outlet member having one or more apertures therein for providing communication of gas from the gas line to the ionization region, and wherein said outlet member is in electrical contact with said anode”*. In the second Official Action on the parent application, at paragraph 2, the Examiner indicated that Kaufman teaches that “a channel is formed behind the cylindrical anode which has an outlet that has at least one aperture leading into the ionization zone”. With respect, claim 25 requires several related features not taught by Kaufman. Firstly, the outlet member must be electrically conductive, and it is conceded that the distributor 42 of Kaufman is electrically conductive. Second, the outlet member is required to be disposed in the ionization region. Kaufman teaches that the ionization region, or the discharge region, is the region within the conical section of the anode 24 and above towards the cathode (see column 4, lines 44-56; column 7, lines 10-12). The distributor 42 of Kaufman is clearly not shown in the ionization region. Third, the outlet member is required to be in electrical contact with the anode. Kaufman teaches providing the distributor 42 at ground potential, as the Examiner has acknowledged in paragraph 2 of the second Official Action on the parent application. In an alternative, embodiment described at column 9, lines 45-54, the distributor is allowed to float so that

it may gain a slight positive potential due to ions expelled from the discharge region striking the distributor. In neither embodiment is the distributor in electrical contact with the anode. That is, Kaufman does not teach an electrically conductive outlet member disposed within the ionization region and in electrical contact with the anode, as required by present claim 25. The presently claimed combination provides a concentration of the electron flow at a location in immediate proximity to the location of gas introduction, thereby providing the benefits as described in the present application including greater stability and a greater operating range of the ion source. Applicant respectfully submits that the invention as defined by present claim 25 is patentably distinguished from Kaufman.

Yoshikawa teaches a Hall accelerator in which ionisation of the gas occurs in a pre-ionisation area by way of a magnetron type discharge, see for example column 5 lines 19 to 28. That is, the combination of the local magnetic and electric fields cause dissociation of the neutral gas molecules without electron collisions. Further, Yoshikawa teaches, at column 6, lines 18-23 that with the magnetic field as depicted in Figure 1, movement of electrons between the main discharge area and the pre-ionisation area is suppressed such that the electrons can not flow from the cathode to cause ionisation of the gas. Accordingly, Yoshikawa does not relate to an ion source, having an electron producing cathode, in which a flow of electrons from a cathode to an anode cause ionisation of a gas. Accordingly, Yoshikawa cannot anticipate the invention as presently claimed in claims 1, 20 and 25.

Furthermore, the gas inlet GI depicted in Figure 1 of Yoshikawa would appear to provide a circumferential opening to the pre-ionisation region. There is no teaching or suggestion that the gas is provided to the ionization region in proximity to a concentration of electrons.

Examiner has indicated that Yoshikawa discloses providing the anode walls with a coating of oxygen free copper. Whilst the coating may be oxygen free, this does not constitute a non-oxidizing surface. It is well known that copper will oxidize under many normal conditions, and in particular when subject to an oxygen plasma environment as in the anode of the present invention. Accordingly, the provision of a copper coating on the walls of the anode of the Kaufman ion source would not prevent a dielectric build up of

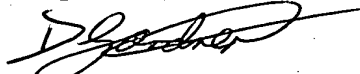
invention as claimed by claim 25. The term "the or each" therefore refers to the alternative grammatical terms that depend on the number of apertures that might be present. The claim defines that, if only one aperture is present, "the" aperture introduces gas into the ionization region at a localized area. In the alternative where multiple apertures are present, the claim defines that "each" aperture introduces gas into the ionization region at a localized area.

This is common patent language for expressing these alternative possibilities and it is respectfully submitted that the claim language is clear and definite, and that the Examiner's objection to the claim is hereby traversed.

Summary

In order to facilitate expedient prosecution of the present application, Applicant has herein provided detailed reasoning addressing all issues that remained outstanding during prosecution of the parent application. Applicant respectfully requests favourable consideration of the present application in light of the submissions made herein.

Respectfully submitted,



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copper oxide which would operate to shield the anode potential. Applicant therefore respectfully submits that the combination of Kaufman and Yoshikawa would not teach an ion source as defined in present claim 20.

Alexander teaches an annular anode having outer tubular walls 104, inner tubular walls 105 and an annular adjoining wall 106. Alexander is silent as to the configuration of the electric field produced between the cathode filament 125 and the anode. However, by showing an annular configuration, it can generally be assumed that the electric field will not be concentrated and therefore that the electrons emitted by the cathode will generally disperse through the ionisation region 103A. Gas is introduced to the ionisation region through inlet 174 disposed near the annular anode wall 106 and diametrically opposite the cathode filament. There is no teaching or suggestion in Alexander that this configuration provides an arrangement where the gas is introduced in proximity to a region of concentrated or maximum electron flow as required by present claim 1. There is also no teaching or suggestion that the anode surfaces are comprised of an electrically conductive non-oxidising material as required by present claim 20.

US 5,656,819 to Greenly does not disclose an ion source as claimed in present claim 1. Greenly describes an ion source where the gas is ionized by means of field excitation from appropriately arranged coils. There is no electron flow from the cathode to the anode providing ionisation of the gas as defined in the present set of claims – see in particular claim 1 of Greenly which states that the ions are “*created from a gaseous substance delivered to the ionisation zone and ionized by the fast coil means*”. Accordingly Greenly cannot anticipate the present claims.

GB 2295268 discloses an ion source wherein the walls of the ionisation chamber have Molybdenum as the main ingredient. GB 2295268 teaches that the chamber walls can often be sputtered, leading to contamination of the deposited film or unwanted deposition on other parts of the ion source such as the cathode. That is, the problem that GB 2295268 is concerned with is the removal of material from the chamber walls. GB 2295268 teaches a solution where the chamber walls are coated to prevent the walls from being sputtered, thus making the walls resistant to chemical etching by ions and radicals.

By contrast, the present application teaches on page 2 lines 11 to 27, that the present inventor has identified that one cause of instability in prior art sources is the build

up of a dielectric layer on the anode which leads to shielding of the anode potential. The present application teaches a solution to this problem, that being to provide the anode with an exterior surface of an electrically conducting non-oxidising material. This solution is the subject matter of claim 20. That is, the present invention as defined by claim 20 is concerned with unwanted deposition from the source gas, not sputtering by ions and radicals as described in GB2295268. Further, it is deposition on the anode, rather than the chamber walls, that is the concern of the present invention as defined by present claim 20.

An anode of this construction is neither taught nor suggested by GB 2295268. GB 2295268 provides minimal details of the anodes used in the ion sources disclosed thereby, see for example the anode 34 of Fig. 3, or the anode 54 of Fig. 7. GB2295268 is silent as to the problems identified in the present application, and does not disclose or suggest providing an anode as claimed in claim 20 having an exterior surface comprised of a non-oxidising, electrically conductive material.

The combination of GB2295268 with any or all of Kaufman, Yoshikawa or Alexander will not teach the invention as presently claimed because the combined disclosures do not teach or suggest providing an anode the exterior surface of which is comprised of an electrically conducting, non-oxidising material.

As detailed above, it is Applicant's belief that the citations, individually or collectively, do not disclose essential integers of the independent claims, and it is therefore Applicant's contention that the claims are novel and inventive over the prior art of record.

#### Claim objection

In paragraph 5 of the second Official Action on the parent application, Claim 22 was rejected as being indefinite due to the phrase "wherein the or each of said apertures".

In light of the amendments arising in the present claim set, claim 22 which was dependent on claim 19 now corresponds with claim 28, dependent on claim 25.

Claim 25 to which claim 28 is appended defines "one or more apertures". That is, there is at least one aperture, but in some embodiments there may be a plurality of apertures, the specific number of apertures being largely irrelevant for the purpose of the

Marked up copy of the claims :

1. (amended from parent claim 1) An ion source [including] comprising an electron producing cathode, an anode, an ionization region between said cathode and said anode, [means] a gas supply path for introducing an ionizable gas into said ionization region, means for creating a potential difference between said cathode and said anode to produce a flow of electrons from said cathode toward said anode, said electron flow passing substantially through said ionization region and causing ionization of said gas, said potential difference also acting to expel ions created in said ionization region from said ion source, means for concentrating said electron flow to create a region within said ionization region where the electron flux is a maximum, [means for acting to expel ions created in said ionization region from said ion source] wherein [said path ionizable gas is introduced into said ionization region at a localized area] said gas supply terminates in at least one aperture disposed in proximity to said region of maximum electron flux.

20. (amended from parent claim 14) An ion source [including] comprising an electron producing cathode, an anode, an ionization region between said cathode and said anode, [means] a gas supply path for introducing an ionizable gas into said ionization region, means for creating a potential difference between said cathode and said anode to produce a flow of electrons from said cathode toward said anode, said electron flow passing substantially through said ionization region and causing ionization of said gas, said potential difference also acting to expel ions created in said ionization region from said ion source, [and means for acting to expel ions created in said ionization region from said ion source] wherein said anode has at least one surface exposed to said ionization region, at least a portion of said at least one surface being of an electrically conductive non-oxidizing material.

25. (claim 19 of parent as amended in response to first office action) An ion source [including] comprising an electron producing cathode, an anode, an ionization region between said cathode and said anode, [gas introducing means] a gas supply path for introducing an ionizable gas into said ionization region, means for creating a potential difference between said cathode and said anode to produce a flow of electrons [from]



produced by said cathode toward said anode, said electron flow passing substantially through said ionization region and causing ionization of said gas, [and ion expelling means acting to expel ions created in said ionization region from said ion source] said potential difference also acting to expel ions created in said ionization region from said ion source, wherein said [gas introducing means includes] gas supply path comprises a gas line terminating in an electrically conductive outlet member disposed within said ionization region, said outlet member having one or more apertures therein for providing communication of gas from the gas line to the ionization region, and wherein said outlet member [provides at least a portion of said anode] is in electrical contact with said anode.

31. (new) An ion source comprising an electron producing cathode, an anode, an ionization region between said cathode and said anode, a gas supply path for introducing an ionizable gas into said ionization region, means for creating a potential difference between said cathode and said anode to produce a flow of electrons produced by said cathode toward said anode, said electron flow passing substantially through said ionization region and causing ionization of said gas, said potential difference also acting to expel ions created in said ionization region from said ion source, wherein said anode comprises an end wall, a side wall extending from the end wall in the direction of the cathode and sloping outwardly in the direction from the end wall toward the cathode such that the end wall and side wall together define a substantially conical ionization region with a closed end at the end wall and with an open end toward the cathode, and wherein said gas supply path comprises one or more channels extending through said anode side wall, each of said channels terminating at an aperture disposed substantially adjacent said end wall.

35. (new) An ion source comprising an electron producing cathode, an anode, an ionization region between said cathode and said anode, a gas supply path for introducing an ionizable gas into said ionization region, means for creating a potential difference between said cathode and said anode to produce a flow of electrons produced by said cathode toward said anode, said electron flow passing substantially through said ionization region and causing ionization of said gas, said potential difference also acting

to expel ions created in said ionization region from said ion source, wherein said anode comprises an end wall, a side wall extending from the end wall in the direction of the cathode and sloping outwardly in the direction from the end wall toward the cathode such that the end wall and side wall together define a substantially conical ionization region with a closed end at the end wall and with an open end toward the cathode, and wherein said gas supply path comprises one or more tubes extending into said ionization region, each tube terminating in an aperture disposed adjacent the end wall.

40. (new) An anode for an ion source, the anode comprising an end wall, a side wall extending from the end wall and sloping outwardly in the direction away from the end wall such that the end wall and side wall together define a substantially conical region with a closed end at the end wall and with an open end at an end of the anode opposite the end wall.